

27. A microelectronic device for storing digital information, the device having a switchable ohmic resistance between electrodes, which said ohmic resistance is reversibly switchable between different states in response to application of different voltage pulses to the electrodes, each different state corresponding to a different value of stored information; wherein the ohmic resistance is formed from a substance comprising components  $A_x$ ,  $B_y$ , and oxygen  $O_z$ , in which:

said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium;

said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA; and

said substance comprising a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%.

28. The microelectronic device according to claim 27, wherein the ohmic resistance is switchable between at least a first state of the different states and a second state of the different states by applying to the electrodes a first voltage pulse of the different voltage pulses for switching from said second state to said first state or a second voltage pulse of the different voltage pulses for switching from said first state to said second state.

29. The microelectronic device according to claim 28, wherein the ohmic resistance in the first state is higher than in the second state and wherein the first voltage pulse of the different voltage pulses for switching to said first state has an opposite sign to the second pulse of the different voltage pulses for switching to said second state.

30. The microelectronic device according to claim 27, wherein each of the different states is obtainable by an erase pulse for switching the ohmic resistance in the region to

a high ohmic state of the different states or by providing at least one write pulse for switching from said high ohmic state to a lower ohmic state of the different states.

31. The microelectronic device according to claim 30, wherein the erase pulse has different amplitudes for switching to one of the lower ohmic states .

32. The microelectronic device according to claim 27, wherein the different states are readable by a read voltage smaller in magnitude than the different voltage pulses applied for switching to the different states.

33. The microelectronic device according to claim 27 being usable as a capacitor-like structure, wherein the ohmic resistance represents a dielectric.

34. The microelectronic device according to claim 27, whereby a specific ohmic resistance related to one of the different states remains after one of the different voltage pulses that leads to said specific ohmic resistance has been applied to the electrodes.

35. The microelectronic device according to claim 27, wherein said store digital information is representable by different values in ohmic resistance of a region, thereby preferably storing two or more bits as digital information.

36. The microelectronic device according to claim 27, in which the combinations of indices x, y and z of the substance are definable by

$x = n + 2, y = n + 1, z = 3n + 4$ , with  $n = 0, 1, 2, 3$ ; or

$x = n + 1, y = n + 1, z = 3n + 5$ , with  $n = 1, 2, 3, 4$ .

37. The microelectronic device according to claim 27, in which the combinations of indices x, y and z of the substance are definable by either of:

$x = 1, y = 1, z = 1$ , and one of the indices x or y being 0; or

$x = n, y = n, z = n + 1$ , with  $n = 1$  or 2 and one of the indices x or y being 0; or

$x = n, y = n, z = 2n + 1$ , with  $n = 2$  and one of the indices x or y being 0.

38. The microelectronic device according to claim 27, in which the combinations of indices  $x$ ,  $y$  and  $z$  of the substance are definable by

$x = n$ ,  $y = n$ ,  $z = 3n$ , with  $n = 1$ , or 2, or 3; or

$x = n + 1$ ,  $y = n$ ,  $z = 4n + 1$ , with  $n = 1$ , or 2.

39. The microelectronic device according to claim 27, comprising a dopant of Chromium or Vanadium at an amount larger than 0% and smaller than 5%, preferably about 0.2%.

40. The microelectronic device according to claim 27, wherein at least one of the components  $A_x$  or  $B_y$  of the substance comprises a combination of elements out of one group or out of several of the corresponding groups of A, and B, respectively.

41. The microelectronic device according to claim 37, wherein the substance is present in the form of a superlattice made by a combination of structural unit cells and/or sub-unit cells.

42. The microelectronic device according to claim 36, wherein the substance is present in the form of a superlattice made by a combination of structural unit cells and/or sub-unit cells having each a different  $n$ , said structural unit cells and/or sub-unit cells being each a member of a corresponding homologous series.

43. The microelectronic device according to claim 38, wherein the substance is present in the form of a superlattice made by a combination of structural unit cells and/or sub-unit cells having each a different  $n$ , said structural unit cells and/or sub-unit cells being each a member of a corresponding homologous series.

44. A memory cell arrangement comprising a microelectronic device, said microelectronic device having a switchable ohmic resistance between electrodes, which said ohmic resistance is reversibly switchable between different states in response to

application of different voltage pulses to the electrodes, each different state corresponding to a different value of stored information; wherein the ohmic resistance is formed from a substance comprising components  $A_x$ ,  $B_y$ , and oxygen  $O_z$ , in which:

said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium;

said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA; and

said substance comprising a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%.

45. A semiconductor device comprising a microelectronic device, said microelectronic device having a switchable ohmic resistance between electrodes, which said ohmic resistance is reversibly switchable between different states in response to application of different voltage pulses to the electrodes, each different state corresponding to a different value of stored information; wherein the ohmic resistance is formed from a substance comprising components  $A_x$ ,  $B_y$ , and oxygen  $O_z$ , in which:

said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium;

said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA; and

said substance comprising a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%.

46. A method for writing information into a memory cell arrangement, said memory cell arrangement comprising a microelectronic device having a switchable ohmic

resistance between electrodes, which said ohmic resistance is reversibly switchable between different states in response to application of different voltage pulses to the electrodes, each different state corresponding to a different value of stored information; wherein the ohmic resistance is formed from a substance comprising components A<sub>x</sub>, B<sub>y</sub>, and oxygen O<sub>z</sub>, in which: said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium; said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA; and said substance comprising a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%; wherein the method comprising the step of:

applying one voltage pulse of the different voltage pulses to the electrodes of said memory cell arrangement for writing information into it.

47. The method according to claim 46, further comprising the step of switching the ohmic resistance in the region between at least a first state of the different states and a second state of the different states by applying to the electrodes a first voltage pulse of the different voltage pulses for switching from said second state to said first state or a second voltage pulse of the different voltage pulses for switching from said first state to said second state.

48. The method according to claim 47, further comprising the steps of providing an ohmic resistance in the first state higher than an ohmic resistance in the second state and providing the first voltage pulse for switching to said first state with an opposite polarity to the second voltage pulse for switching to said second state.

49. The method according to claim 46, further comprising the step of obtaining each of the different states by providing an erase pulse for switching the ohmic resistance to a high ohmic state of the different states or by providing at least one write pulse for switching from said high ohmic state to a lower ohmic state of the different states.

50. The method according to claim 49, further comprising the step of providing an erase pulse with different amplitudes for switching to one of the lower ohmic states.

51. A method for reading information out of a memory cell arrangement, said memory cell arrangement comprising a microelectronic device having a switchable ohmic resistance between electrodes, which said ohmic resistance is reversibly switchable between different states in response to application of different voltage pulses to the electrodes, each different state corresponding to a different value of stored information; wherein the ohmic resistance is formed from a substance comprising components  $A_x$ ,  $B_y$ , and oxygen  $O_z$ , in which: said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium; said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA; and said substance comprising a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%; wherein the method comprising the steps of:

applying a read voltage to said memory cell arrangement and

associating with this information a value of current flowing through said memory cell arrangement; or

applying a current pulse to said memory cell arrangement and

associating with this information a value of voltage appearing between the electrodes of said memory cell arrangement.

52. Use of a substance for storing digital information, the substance comprising components  $A_x$ ,  $B_y$ , and oxygen  $O_z$ , for making a switchable ohmic resistance within a capacitor-like structure, in which:

said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium;

said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA; and

said substance comprises a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%.

53. Use of a substance according to claim 52, wherein the combinations of indices x, y and z are defined by

$x = n + 2$ ,  $y = n + 1$ ,  $z = 3n + 4$ , with  $n = 0, 1, 2, 3$ ; or

$x = n + 1$ ,  $y = n + 1$ ,  $z = 3n + 5$ , with  $n = 1, 2, 3, 4$ ; or

being defined by either of:

$x = 1$ ,  $y = 1$ ,  $z = 1$ , and one of the indices x or y being 0, or

$x = n$ ,  $y = n$ ,  $z = n + 1$ , with  $n = 1$  or 2 and one of the indices x or y being 0, or

$x = n$ ,  $y = n$ ,  $z = 2n + 1$ , with  $n = 2$  and one of the indices x or y being 0; or

being defined by

$x = n$ ,  $y = n$ ,  $z = 3n$ , with  $n = 1$ , or 2, or 3; or

$x = n + 1$ ,  $y = n$ ,  $z = 4n + 1$ , with  $n = 1$ , or 2.